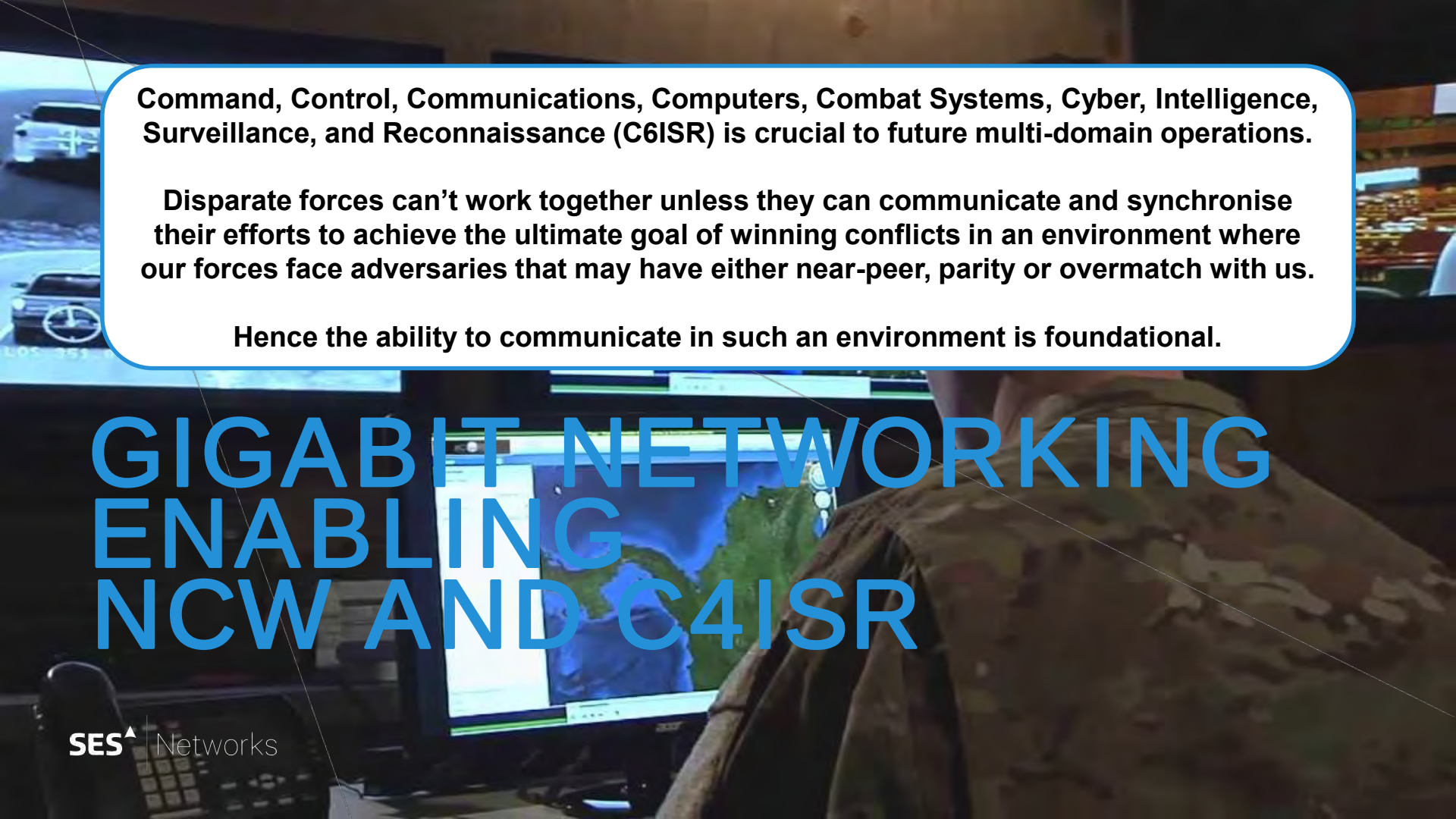
SES Networks

# Gigabit SATCOM capability




PRESENTED BY
Glen Tindall

PRESENTED ON
16 November 2017



Command, Control, Communications, Computers, Combat Systems, Cyber, Intelligence, Surveillance, and Reconnaissance (C6ISR) is crucial to future multi-domain operations.

Disparate forces can't work together unless they can communicate and synchronise their efforts to achieve the ultimate goal of winning conflicts in an environment where our forces face adversaries that may have either near-peer, parity or overmatch with us.

Hence the ability to communicate in such an environment is foundational.

# GIGABIT NETWORKING ENABLING NCW AND C4ISR

SES Networks

# AGENDA




- SES Update
- New Satellite Technologies
- Sea
- Air
- Land
- Australia

SES | Networks




# WHAT WE ARE

**We are a provider of global managed data services**

SES Networks


WHAT
WE DO
We enable high-performance
networked communications
virtually anywhere
SES Networks


HUMANITARIAN
AND SAR
MISSIONS
SES
Networks

# MORALE AND WELFARE NETWORKS



SES Networks




# GOVSATCOM

SES Networks

# COMMS ON THE MOVE




SES Networks

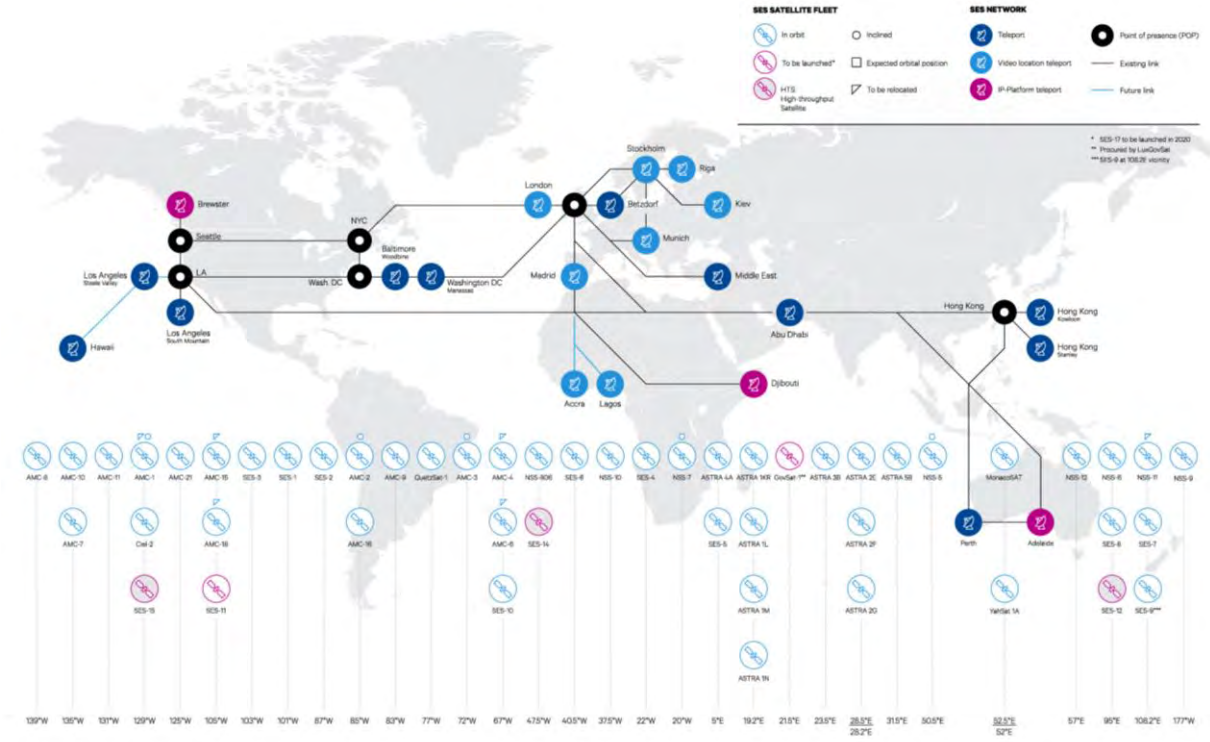
# UNMANNED AIRBORNE MISSIONS



SES Networks


INFRASTRUCTURE
GEO
O3b
mPower
SES Networks

# Differentiated Portfolio
## Satellite Fleet




## Today

55 x GEO satellites

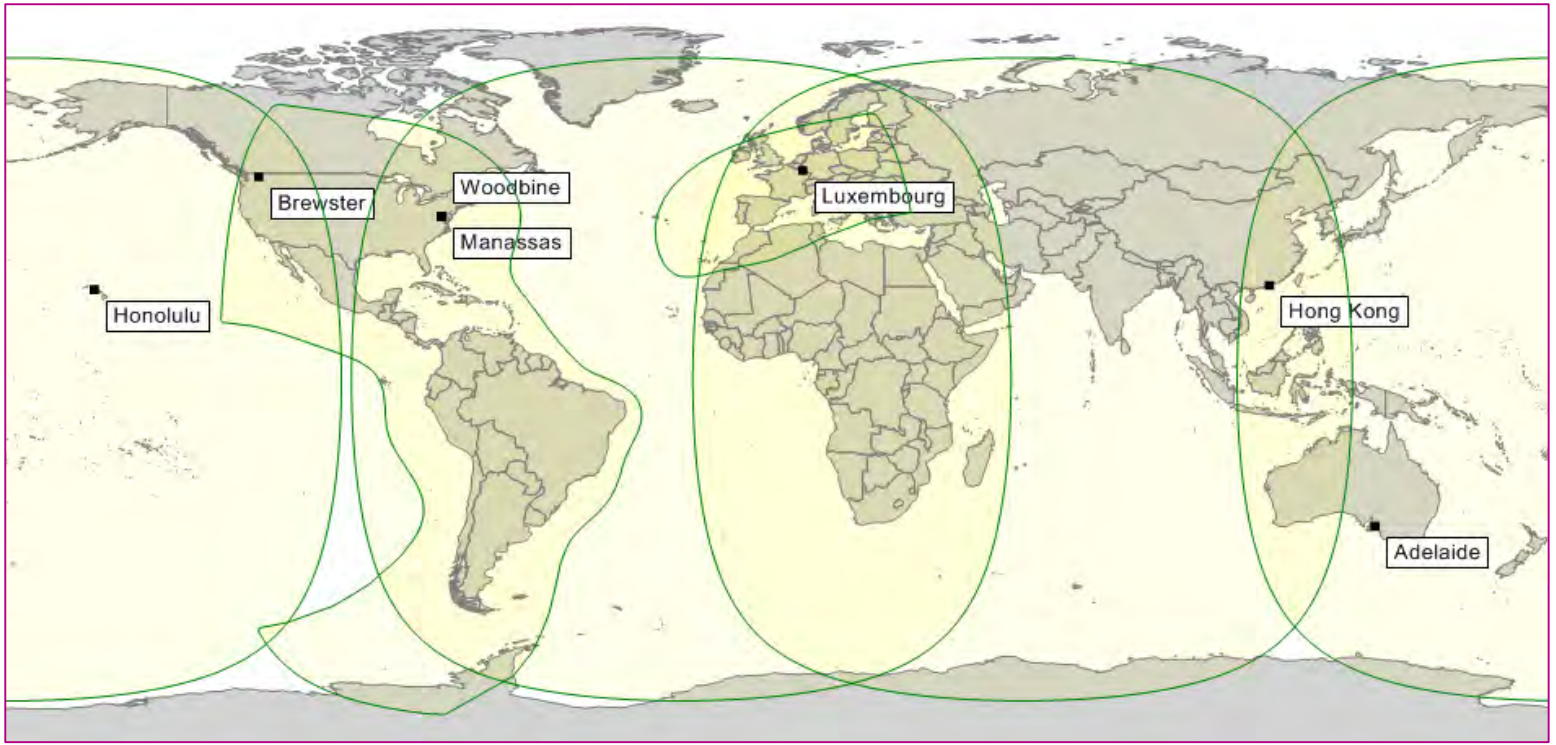
12 x MEO satellites

## In the factory

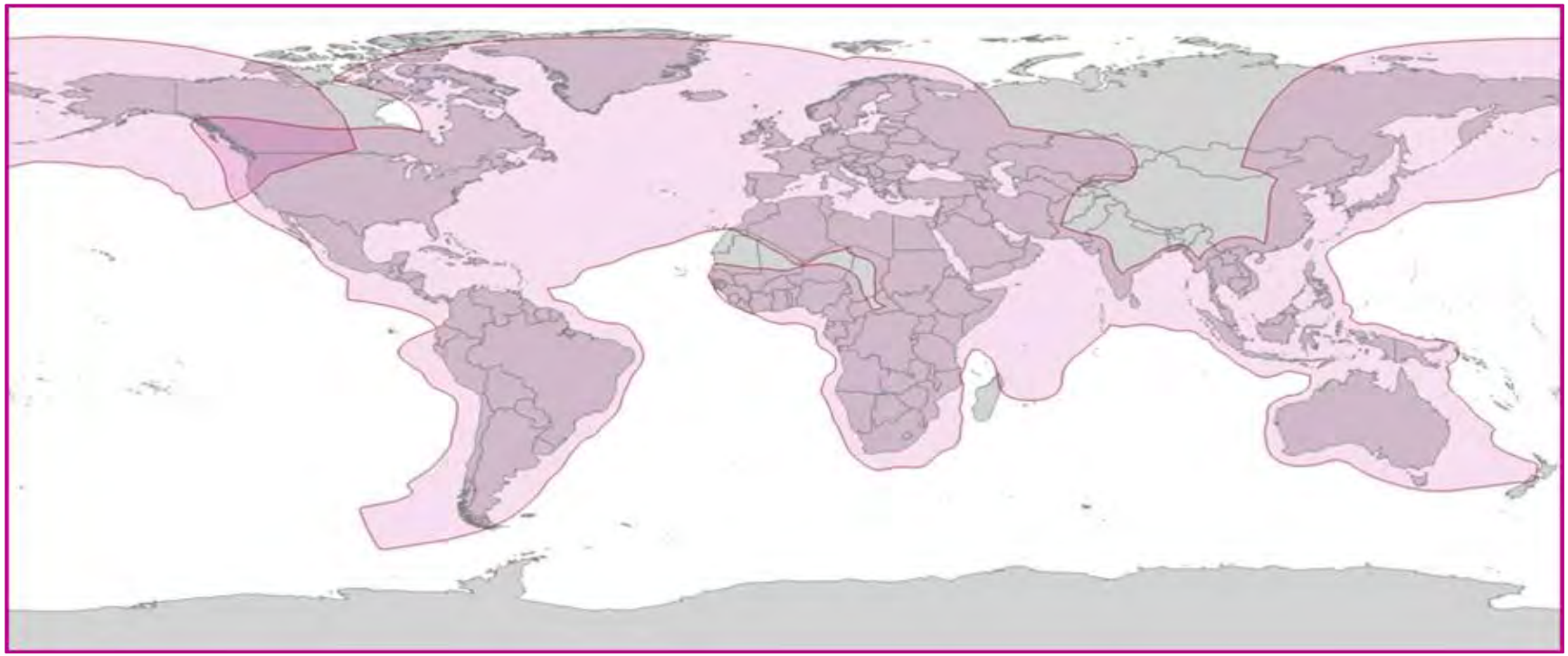
3 x GEO satellites

15 x MEO satellites

# C Band Coverage



# Ku band coverage



# O3b Ka band coverage




Customers can connect to fiber infrastructure through Regional Gateways

# HYBRID HTS SATELLITE ARCHITECTURE



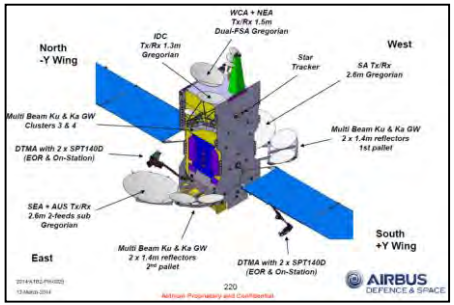
SES Networks

# New GEO Ku capability in APAC region

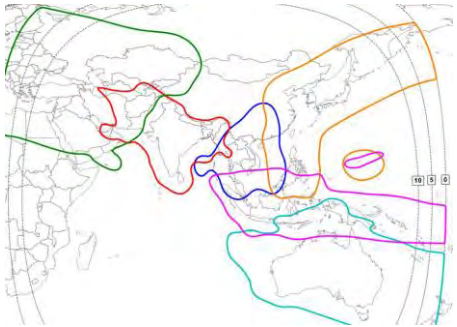
## SES-12 Overview

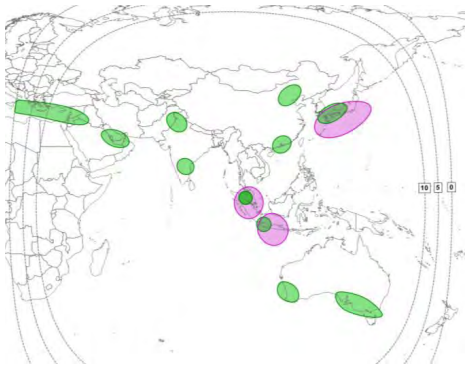


HTS Beams

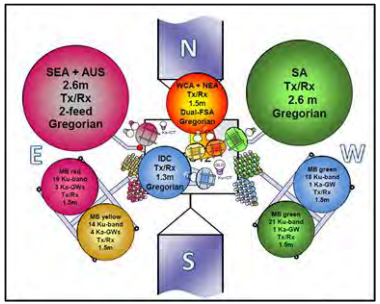



Shaped Beams

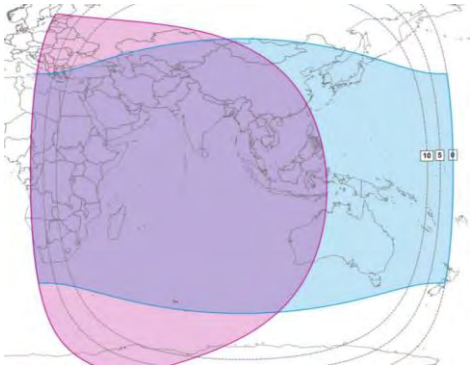




Gateway Beams

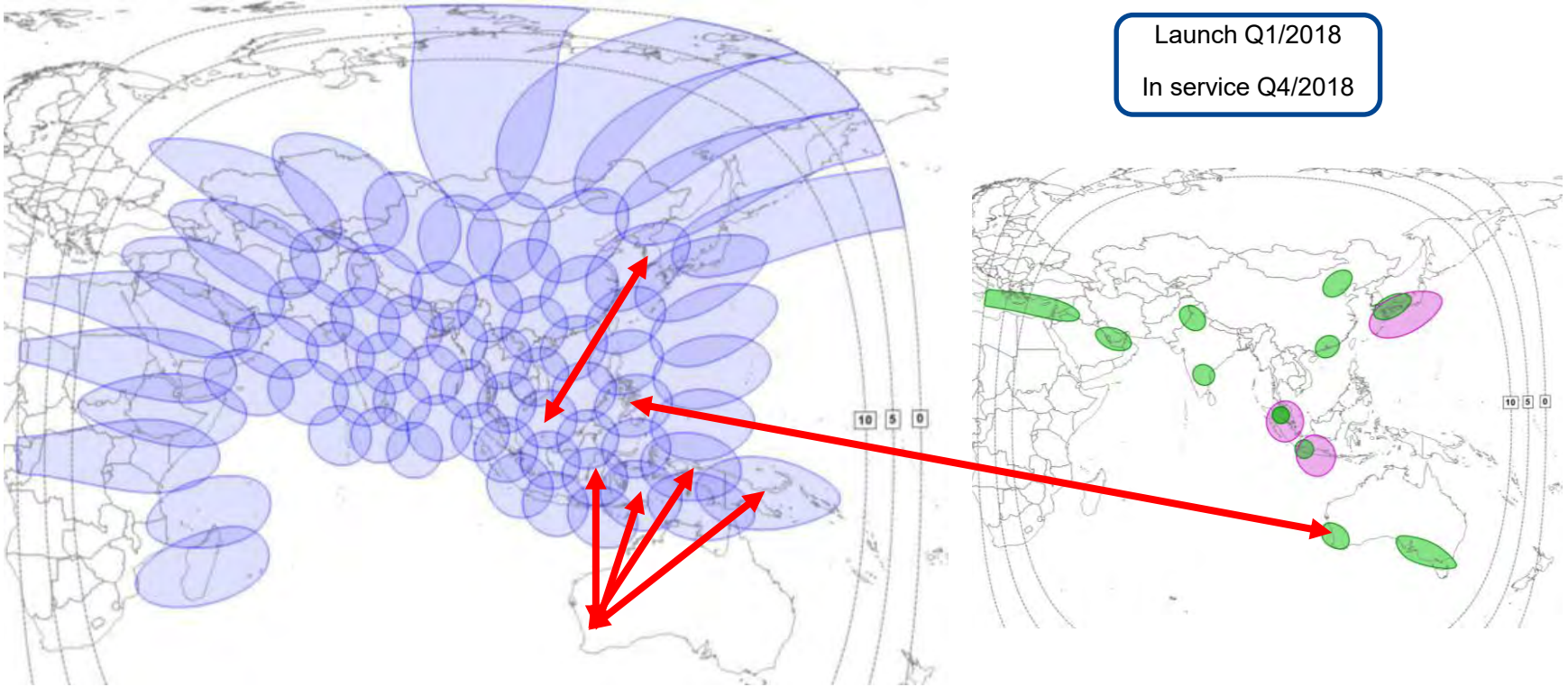



Global Beams

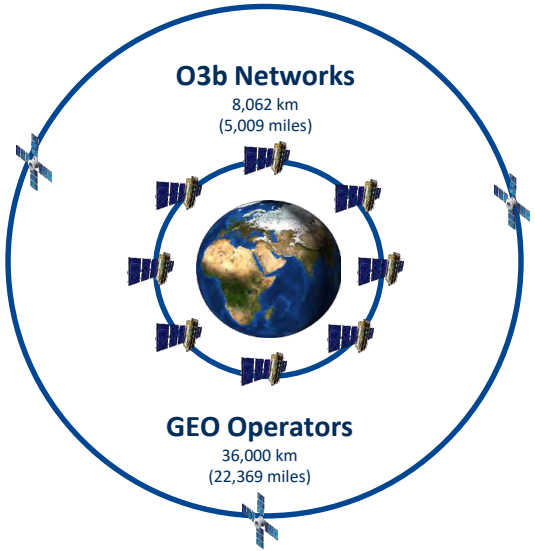


# New GEO capability in APAC region

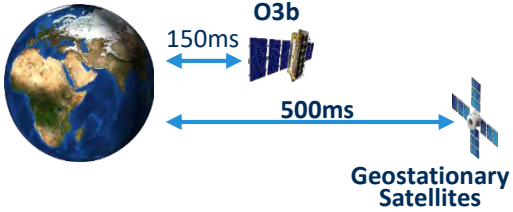
## Connectivity from Australia to any spot beam in Ku band



# O3b
## A global multi-Gigabit satellite constellation




- The fastest growing satellite system in history
- MEO reduces latency by 75% and increases throughput significantly compared with GEO
- Lower cost to build and launch
- O3b's higher throughput and lower latency dramatically improves satellite service
- Significantly improved link performance compared with GEO Ka satellites



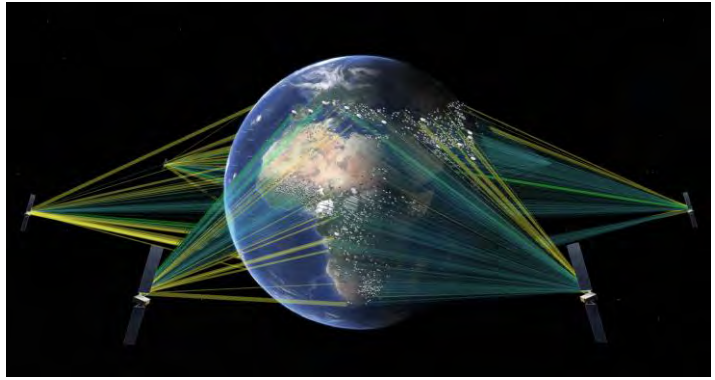
# O3b animation

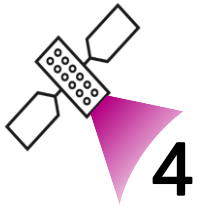


# mPower: A New MEO Constellation

## Ka band Global Service entering service in 2021

- State of the art encryption standards
  - Military grade Command and Telemetry crypto (CNSSP-12 compliant)
  - Crypto agnostic for customer services
- Bespoke Service
  - Multi Application with tailored coverage supported by MEO latency of less than 150 msec
  - Full flexibility on gateway location (in theatre and/or key POP's) with the ability to provide multiple routes to a single user terminal.
  - Waveform agnostic with fully transparent repeater
- Robust Service Plan
  - MEO orbit provides disaggregation in addition to natural resilience of a constellation architecture (i.e. would need to lose all satellites to remove capability)
  - Features such as tracking orbit, large/configurable frequency band, ability to null, small beam footprint and ability to access multiple satellites from a single terminal provide significant defence against jamming.





Shape, moderate, route, shift & switch

**4,000+**

beams per satellite

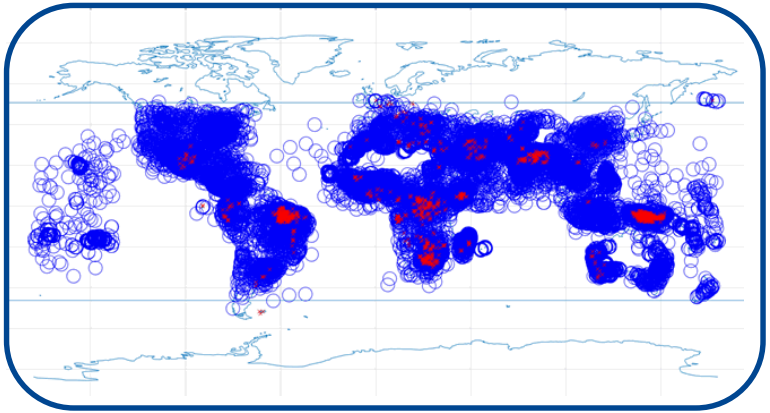
**Multi-terabit**

Scalable to 10s of Tbps globally

# A New MEO Constellation

## Enabling truly global cloud-scale connectivity

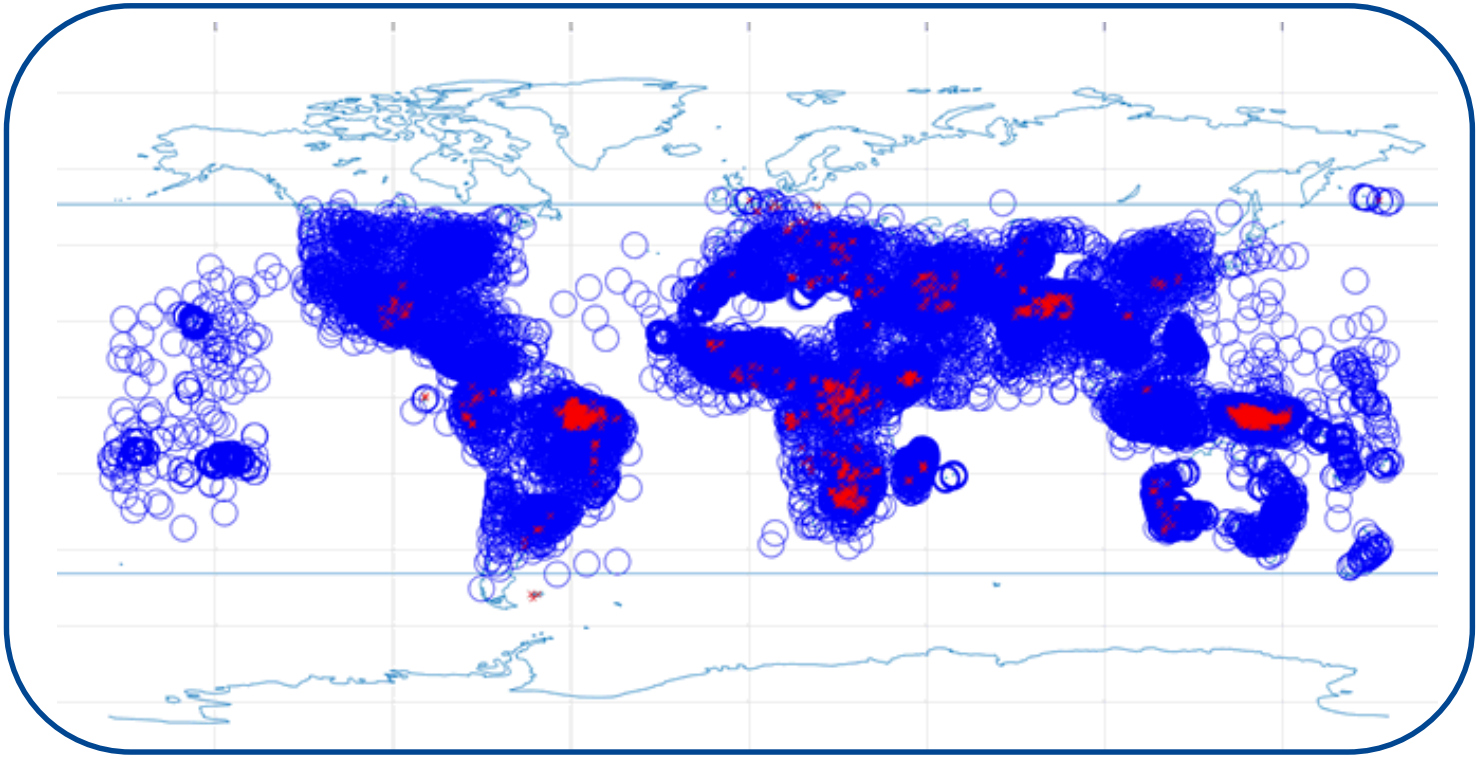
- Frequency Bands
  - Capability to channelize between 15 MHz and 2.5 GHz to a single terminal
  - Full Commercial Ka-band, potential to implement Military Ka *contingent on customer interest*
- Coverage
  - 500 to 4000 beams per spacecraft vs 10 beams per spacecraft today, dependent on final design
  - Capability to create tailored beams in accord with evolving in-theatre requirements
  - Capability to securely update beam locations real time based on terminals/customer needs
  - Global coverage +/-50 degrees latitude
- Very high throughput possible per terminal
  - Throughput per terminal largely limited by terminal capabilities; peak bitrate per user up to 10 Gbps.  Each satellite having 200Gbps of capacity verses 20Gbps today
  - Significant return capability with +20 dB/K G/T GEO equivalent performance, supporting next generation ISR demands.



Next Generation, low latency system with fully customizable beam laydowns which can be adapted to meet changing  theatre demands and deliver unprecedented throughout per beam

# A New MEO Constellation

## Enabling truly global cloud-scale connectivity



# O3b MEO Constellation

## Five significant attributes for Government users

- Secure and Reliable with Low Probability of Jamming, as assessed by the Office of Secretary of Defense, Joint Vulnerability Assessment Branch
- Low latency, guaranteed 150ms or less roundtrip
- High throughput, up to 2 Gbps to a terminal
  - 1.2 Gbps into a 2.4m terminal
  - 400 Mbps into a 0.85m terminal
- Carrier grade quality which enables and optimize video, voice, data and applications
  - Meets Metro Ethernet Compliant (MEF) International carrier standard
  - Meets International Telecommunications Union at the highest level, under ITU G. 114 Voice Quality Model
- Beam Mobility by user, Secure beam mobility without O3b interaction

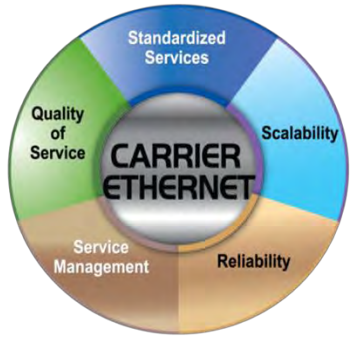
Next Generation, low latency system with fully customizable beam laydowns which can be adapted to meet changing theatre demands and deliver unprecedented throughout per beam

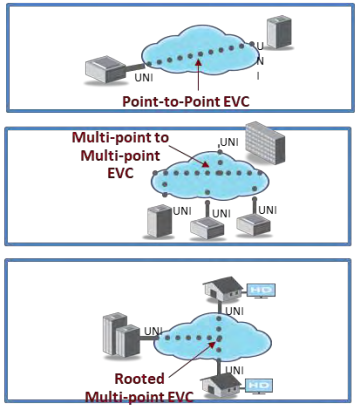
# O3b is Metro Ethernet Forum Compliant

- MEF – Carrier Ethernet

https://www.ses.com/press-release/ses-networks-first-achieve-mef-ce-20-services-certification-over-satellite

- Attributes – Standardized Services
  - E-LINE, E-LAN, E-TREE
  - Ethernet Private Lines (EPL)
  - Ethernet Virtual Private Lines (EVPL)
- Value
  - Connect remote locations with central offices/command
  - Access to cloud resources directly (IaaS, PaaS, SaaS services like AWS, Azure or Salesforce etc.)
  - Connect remote regional resources to the rest of their core network infrastructure
  - Private line connectivity (military applications)
  - Circuit Emulation Applications



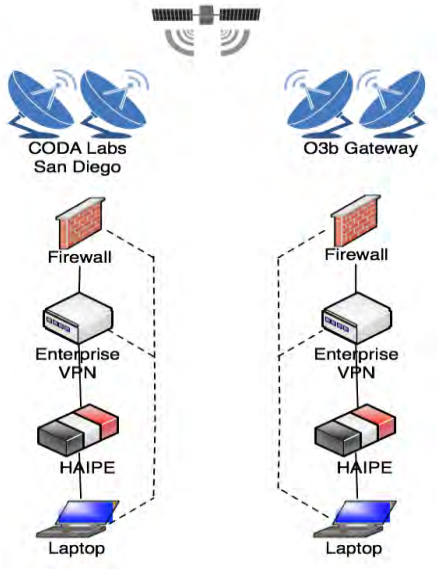
# Extensive Testing
## U.S. Government Test & Evaluation (T&E) Demonstrations

- COMPACFLT/COMSEVENTHFLT, TRIDENT WARRIOR 2015 (TW-15)
- Joint Communication Support Element (JCSE) & U.S. Special Operations Command & Central Command Tampa, FL, 13 – 23 October 2014
- TRIDENT SPECTRE 2015, NSWC, JEB Little Creek-Fort Story (Maritime)
- TRIDENT SPECTRE 2016, NSWC, JEB Little Creek-Fort Story (Land)
- U.S. Marine Corps, MCTSSA, Camp Pendleton, CA,
- I MEF / 1st MEB DAWN BLITZ Exercise in conjunction with 3rd Fleet – September 2015
- Special Reconnaissance Team – One (SRT-1), U.S. Navy WARCOM
  - Scan Eagle operations and deployments
  - Team Work Ups
  - Operations within PACOM AOR

Further details available as a separate briefing as either CLASSIFIED or UNCLASSIFIED

# Encryption over O3b

- Validated and characterized the performance of U.S. Government High Grade cryptographic solutions over O3b
- High Assurance Internet Protocol Encryptor (HAIPE)
- All encryption testing used the HAIPE v4.1 compliant devices
- Network jitter never exceeded 2ms during any phase of testing
- Total latency was not observed in excess of 142ms
- These network characteristics are not only ideal for the application of HAIPE devices
  - Should be found acceptable to nearly any user's application.
- All encryption devices worked over the O3b system



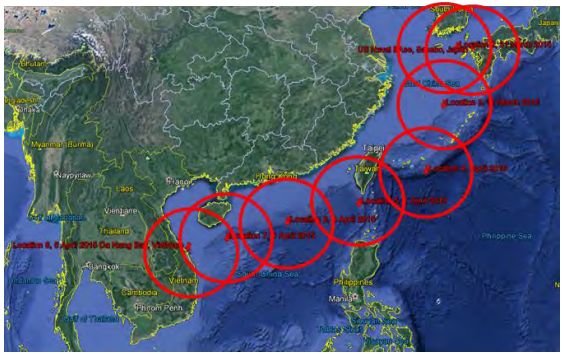





# Top 10 headline results from testing with US DoD

- “Low Probability of Jamming” per JVAB
- 10x performance improvement for SIPRNet and NIPRNet vs. GEO satellite
- Reach back through secure DoD infrastructure
- Enable low-latency Cloud Services
- Large file transfers, demonstrated up to 2 Terabyte file transfer
- Secure beam mobility, without SES Networks intervention





- Supports current VOIP systems, 4G LTE and Advanced LTE Standards
- 400Mbps –1 Gbps easily transportable terminals to augment field systems and capabilities
- Multi-site high throughput distributed operations, closed system
- Fibre like experience in support of LandWarNet/GIG attributes

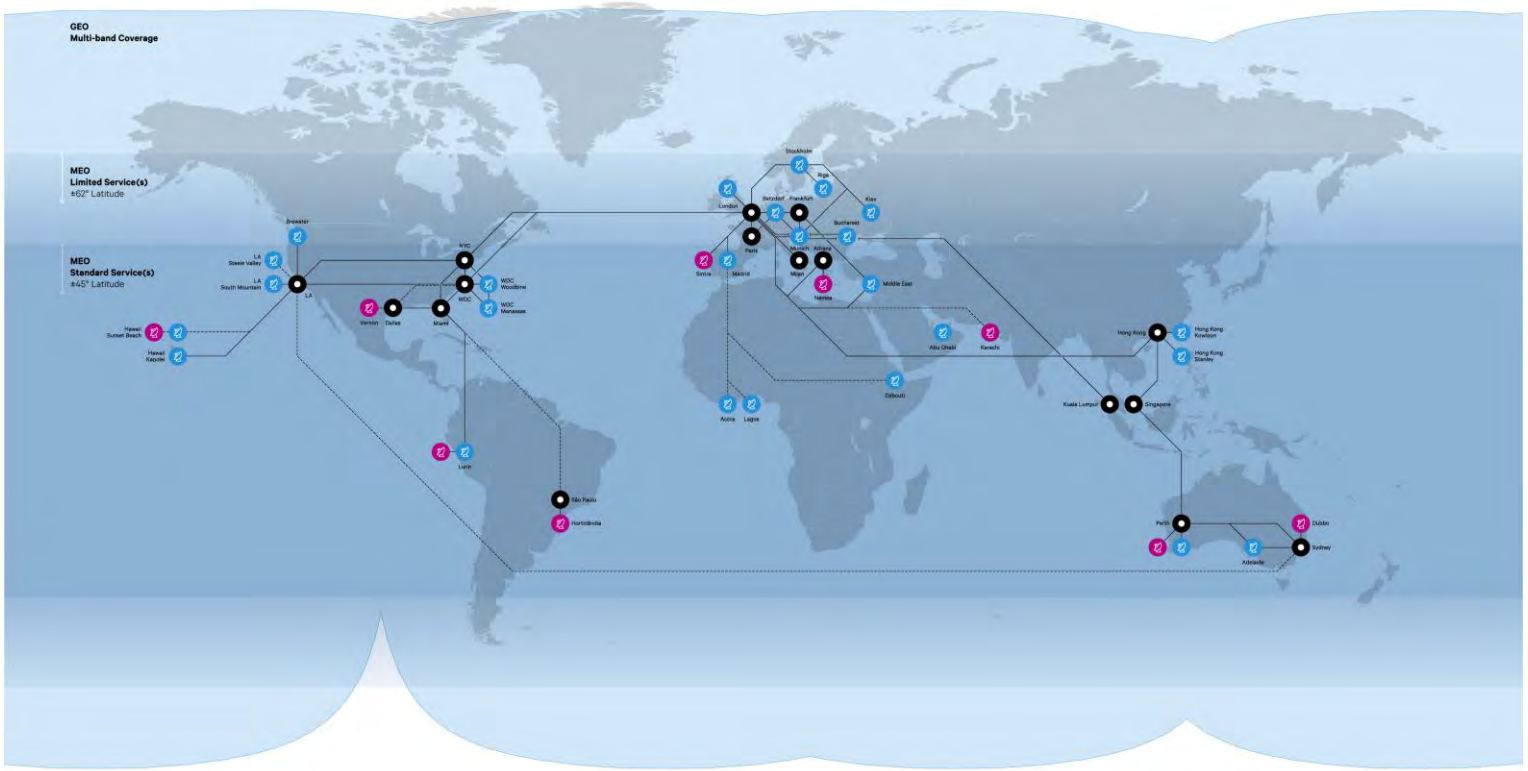



# MARITIME CONNECTIVITY

SES Networks

# Maritime coverage in C, Ku, Ka

## Network Coverage



# USS Fort Worth (LCS-3) – Trident Warrior 2015

## Exercise Outline

- US 7th Fleet Sponsored and Directed Exercise
- Limited Objective Exercise 1
  - UNCLASSIFIED April 2015
- Limited Objective Exercise 2
  - CLASSIFIED August 2015
- NIPERNET & SIPERNET
- Reachback to PACOM, PACFLT, 7thFLT, SPAWAR. LCSRON, SURFLT
- Demonstrate LTE throughout LCS-3
- Demonstrate Live Virtual Tour over YouTube using Google Hangout



# USS Fort Worth (LCS-3) – Trident Warrior 2015

## Network High Level Architecture

- Single 1.2m Orbit System/Viasat modem on LCS-3
- From LCS-3 to Perth Australia O3b Gateway via O3b Satellite
- O3b Perth to Pentagon via fibre (18637 km)
- From Pentagon to end user in continental US





# USS Fort Worth (LCS-3) – Trident Warrior 2015

## Test Results

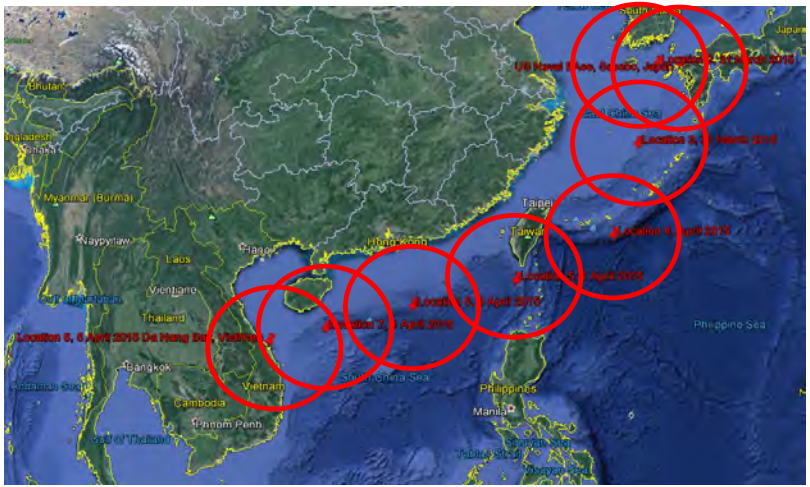
Demonstrated US Navy self-steering beam securely

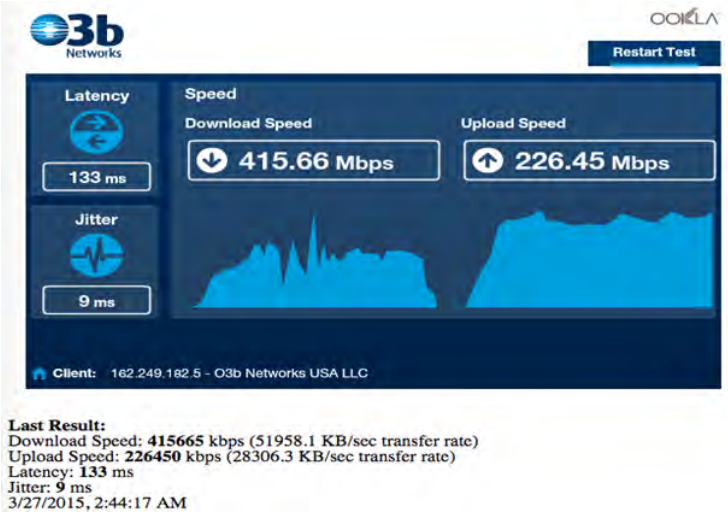
Demonstrated IP throughput of 400/200Mbps

Demonstrated Total Latency of 450ms

Satellite Latency 150ms

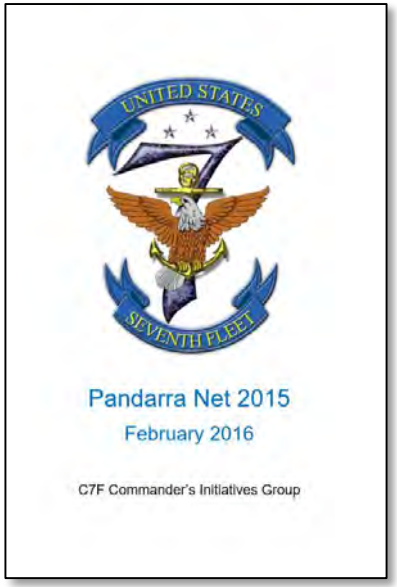
Terrestrial Latency 300ms



# USS Fort Worth (LCS-3) – Trident Warrior 2015
## References

- Onboard LCS-3 since March 2015
  - O3b & 4G/LTE
- US 7th Fleet conducting experiments in 2 phases
  - Phase I – NIPERNET
  - Phase II – SIPERNET
- VIPs Observing Phase I
  - Commander Seventh Fleet
  - Commander US Pacific Fleet & Staff
  - USN Balboa Hospital San Diego, Staff
  - Commander US SPAWAR and Staff
  - Commander, US Naval Surface Forces
  - Commander, US Naval Aviation Forces
  - Chief of Navy, Royal Australian Navy
  - Chief of Staff, Japan Maritime Self-Defense Force
- US Chief of Naval Operations (CNO) used as Public Affairs opportunity through virtual tour
  - http://navylive.dodlive.mil/2015/04/09/uss-fort-worth-hangout-tour/




Report can be provided in a private briefing

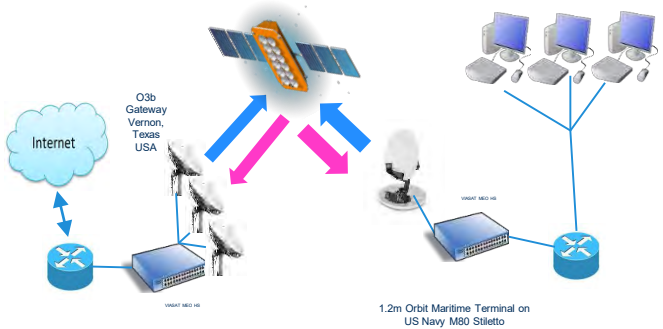



# AMPHIBIOUS OPERATIONS

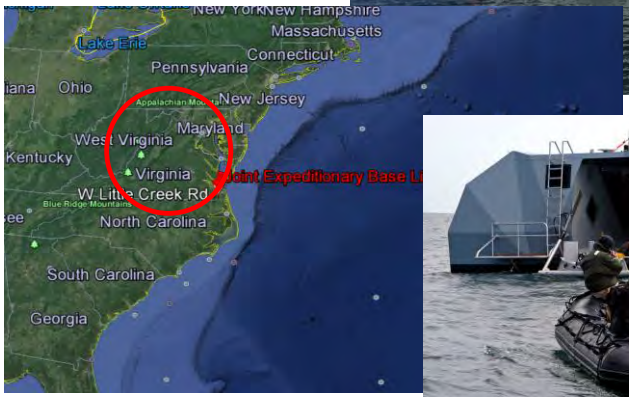
SES Networks

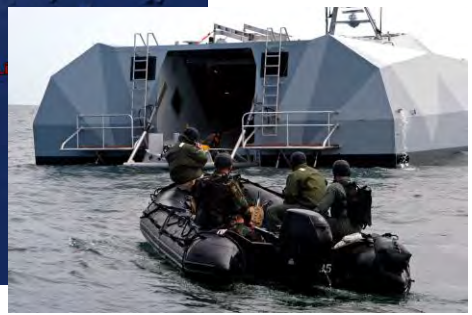
# Naval Special Warfare Command
## M80 Stiletto - Trident Spector 2015

- Joint Expeditionary Base
- Single 1.2m Orbit antenna system, Viasat modem
- Single antenna 20 sec to reacquire satellite
- Beam connected to a US Gateway, US IP routed
- O3b Reach-back from a Special Warfare Vessel responsible for SEAL delivery
- System encrypted; No data lost
- Demonstrating 4G/LTE with connectivity to O3b Networks





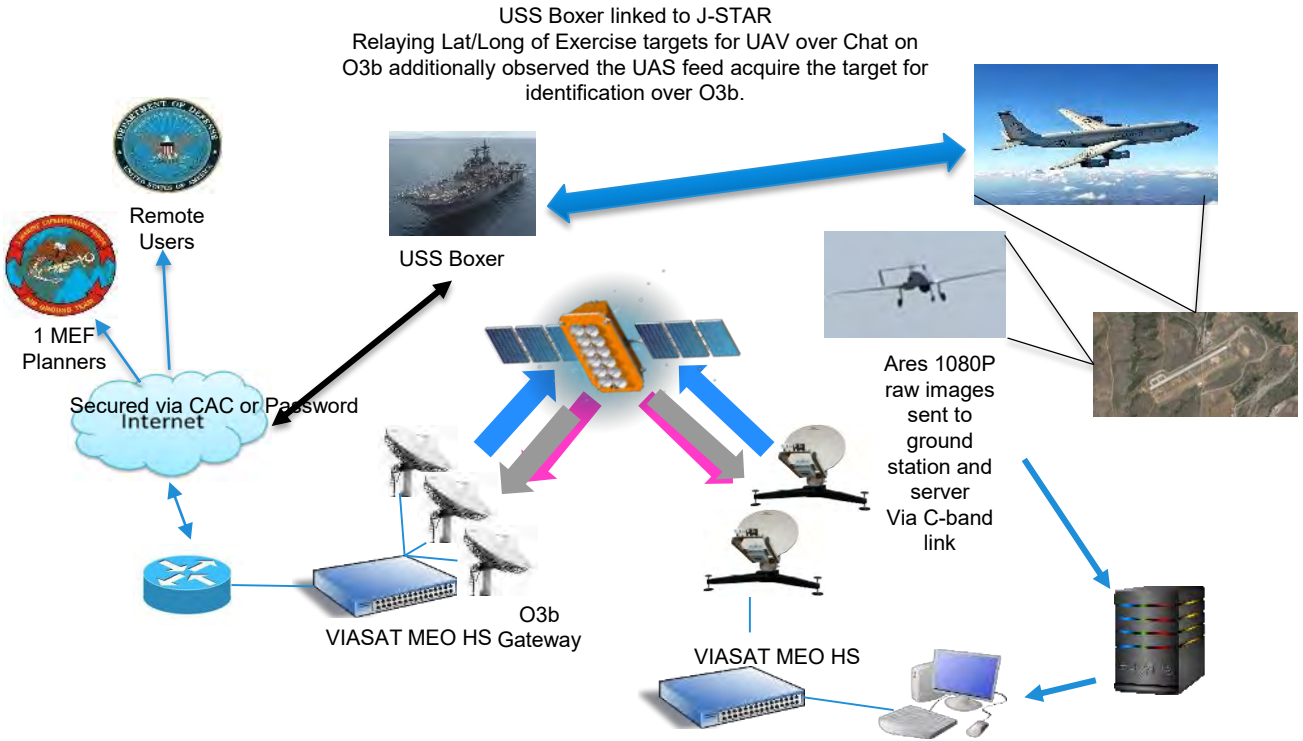
# Dawn Blitz 2015
## Multi-National Amphibious Exercise

- Ares - Group 3 UAV by Shield Aviation
  - FLIR STAR SAFIRE 380 HD (1080p)
  - NAVAIR Flight Clearance
  - 14 hours endurance time
- O3b Networks
  - 24/7 ops using generator in remote environment
  - Downloaded 3.2 Gbyte during first day of operations




Author of the report, report provided
MAJ James D. Neushul
USMC Sr Interoperability Engineer IOB,
USMC MCTSSA
james.neushul@gmail.com

# Dawn Blitz 2015
## Multi-National Amphibious Exercise CONOPS



# Gigabit networking on O3b

## Supporting Civilian and Military applications at sea



- Facebook, IM/Text/Skype chat and video conference
- Add new services to the Passenger Experience
- Consolidate IT infrastructure (Data Center Hosting)
- Improve Voice Call Quality
- Crew welfare

- 100 times throughput of current service
  - Previously 4.5 Mbps aggregate
  - Now 350/150 Mbps = 500 Mbps aggregate



- Broadband access at sea, in and around the ship
- Petabyte of internal data transfer per day
- Mobile Voice, Video and Data ship wide
- NIPRNet and SIPRNet access
- Morale and Welfare networks

- 50 times throughput of current capability
  - CVN currently 12 - 20 Mbps aggregate
  - Now 500/500 Mbps = 1000 Mbps aggregate

# AIRBORNE CONNECTIVITY




SES Networks

# O3b Airborne Solution
## Key Features

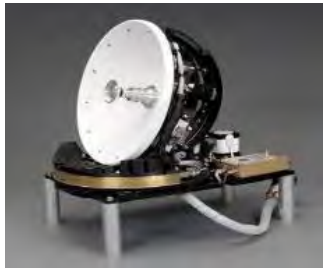
- Mission profiles where high data rate SATCOM is beneficial
  - VIP/C2 Aircraft
  - Tactical ISR Aircraft
  - UAVs
  - Larger Strategic ISR
  - Helicopters for ISR/SAR/C2
- Extensive UAV experience
  - MQ-1 Predator
  - MQ-9 Reaper
  - MQ-1C Gray Eagle
  - RQ-4 Global Hawk
  - Scan Eagle



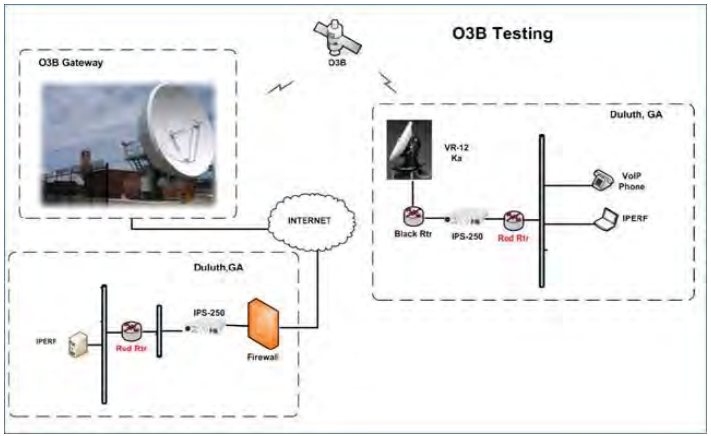

- Key Capabilities
  - Flight Following capable
  - Global quick-reaction response capable
  - Concentrated coverage for dense UAV operational areas, supporting multiple aircraft and sensors
  - Supports smaller antennas for Group 2 & Group 3 UAVs
  - Solves the Equatorial Skew angle issues for equatorial routes
  - Allowing Sensors for MV-22, MH-53, VH-60, SH-60 and others to run in UHD mode
  - Real Forward Link capacity to meet all VIP/ C2 needs (50, 100+ Mbps)
  - Very High ISR Return Data Rates (5, 10, 20, 30 Mbps)

# New airborne antenna systems
## Viasat

- Test Overview
  - Phase I – Antenna & ACU ground testing
  - Phase II – Live flight testing
  - Phase III – Live End Customer Demonstration
- VR-12 (12 inch) demonstrated on O3b
- KuKarray Antenna (18 inch) demonstrated on O3b
- Test results
  - VR-12, 90 Mbps to the airframe, 50 Mbps from the airframe
  - KuKarray, 275 Mbps to the airframe, 50 Mbps from the airframe
- G-12 under development, higher performance







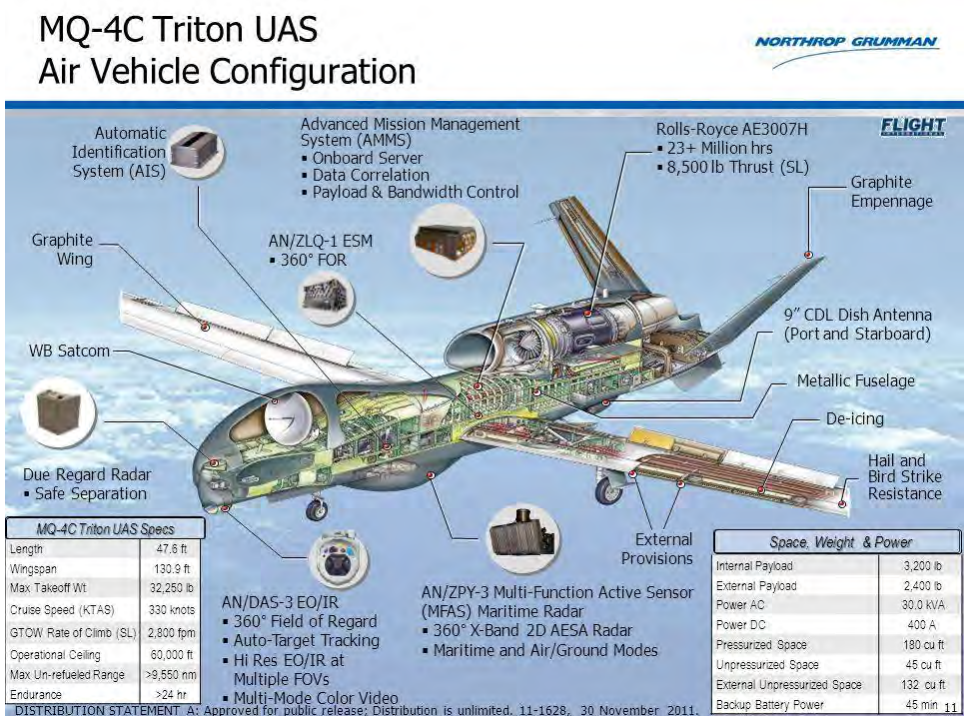
# New airborne antenna systems
## GetSAT



- GetSAT 11 inch terminal
- High slew rate, single terminal operation
- First demonstrated over the SES Ka-band GEO Satellite in 2016
- More recent Joint testing conducted at GetSAT facility in Israel week of 15-19 May 2017 over O3b
  - Preliminary Results
    - 20 Watt BUC with Comtech 760 modem
    - 10 Mbps FWD / 10 Mbps RTN
    - Roundtrip Latency less than 150ms
  - Future Testing
    - 40 Watt BUC with Comtech 760 Modem
    - Anticipated Results 20 Mbps FWD / 20 Mbps RTN
    - Roundtrip Latency less than 150ms

# Example application
## MQ-4C Triton

- Multiple sensor packages available
  - MFAS, EO/IR, AIS Rx, ESM, MTS-B, …
- Radome accommodates up to 1.2m antenna system
- Likely data rates on O3b
  - 400 Mbps to the airframe
  - 200 Mbps from the airframe
- Australian gateway options
  - Dubbo
  - Perth
- Independent beam steering
- JVAB: Low Probability of Jamming



# LAND CONNECTIVITY



SES Networks

# O3b Transportable Terminals

- 1 Metre Class Terminals
  - 0.85m, 1.0m & 1.2m
  - Variable BUC 5W, 10W, 20W & 40W
  - Capable of operating alternative Ka-band Satellite networks (WGS & Global Xpress) with change of feed. Reflectors operate in Ku-band & X-band
- 2 Metre Class Terminals
  - 1.8m, 2.0m & 2.4m
  - Variable BUC 20W, 40W & 250W
  - Capable of operating alternative Ka-band Satellite networks (WGS & Global Xpress) with change of feed. Reflectors operate in Ku-band & X-band









# USMC MCTSSA, Camp Pendleton, CA

- The Marine Corps Tactical Systems Support Activity (MCTSSA) is the Marine Air-Ground Task Force (MAGTF) Command, Control, Communication, Computer, Intelligence (C4I) Integration centre for the United States Marine Corps
- Conducted Test and Evaluation demonstrations of O3b AVL Flyaway Systems within USMC CONOPS, 23 Oct 2015
- Terminals tested were the 0.85m & 2.4m
- Large File download demonstrated
  - 10 GB Downloaded in 3 minutes, 3 seconds
  - 100 GB Downloaded in 27 minutes, 10 seconds
  - 100 GB Uploaded in 36 minutes, 38 seconds
  - 2 TB Uploaded in 6 hours

Eric “Rick” Gay, SATCOM Communications Specialist
USMC MCTSSA, MCTSSA PESG, Bldg 313059, Camp Pendleton, CA
Bus: (760) 725-1758
Bus 2: (760) 725-6077
Email: eric.gay@usmc.mil



# Scan Eagle Operations

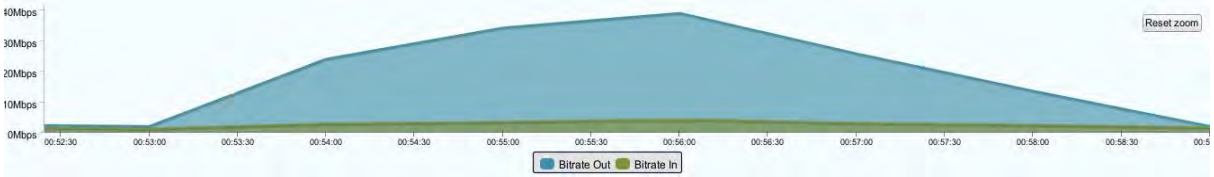
- US Naval Special Warfare Command, San Francisco, CA, 12-22 Oct 2015
- Multiple locations simultaneously
- Diverse Operating Environments
- Multiple Manned and Unmanned ISR feeds simultaneously
- Reach back to and through the SOCOM backbone from CGS
- Full SOTF Operating Environment to include connectivity to CJSOTF

Contact for CLASSIFIED Information on Operations
Lt (USN) Jonathan Shawbell
N6, Special Reconnaissance Team – One (SRT-1)
Naval Special Warfare Command (NSWC)
(619) 537-1010
Jonathan.Shawbell@navsoc.socom.mil

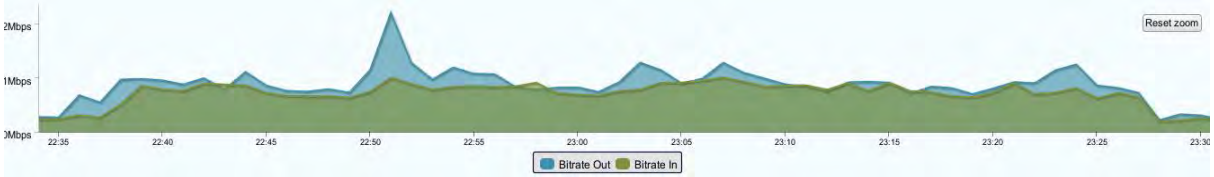


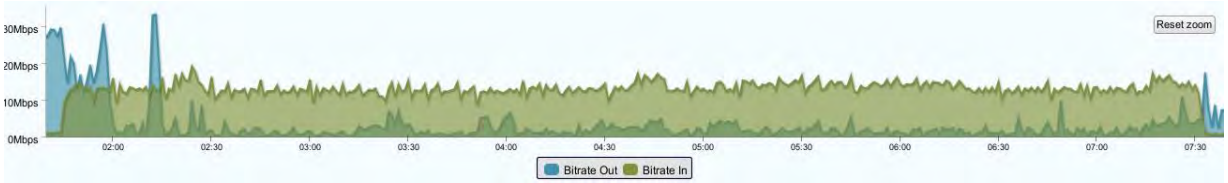
# Scan Eagle Operations
## Traffic records

Download of 0.75 Gigabyte File in 4 minutes




SECURE VTC, 1 Mbps bi-directional for over 1 hour without dropping



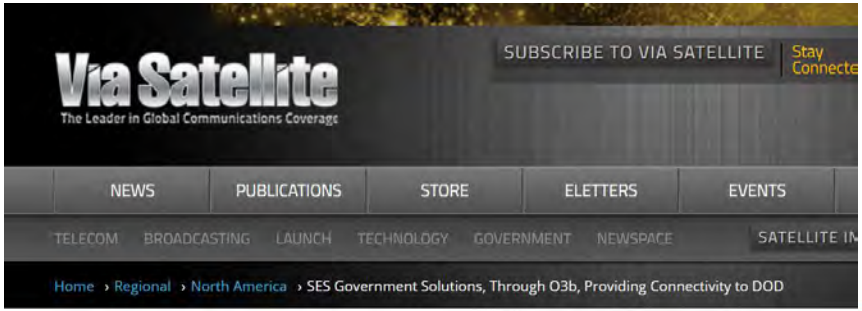



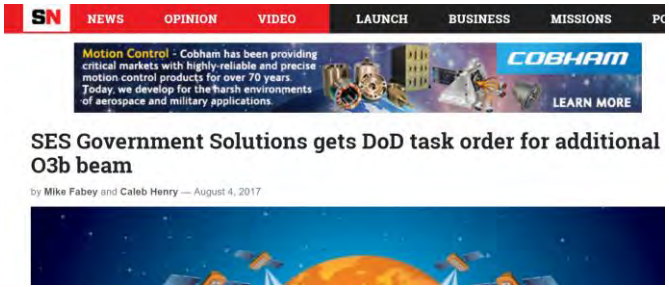
# Scan Eagle Operations
## Traffic records

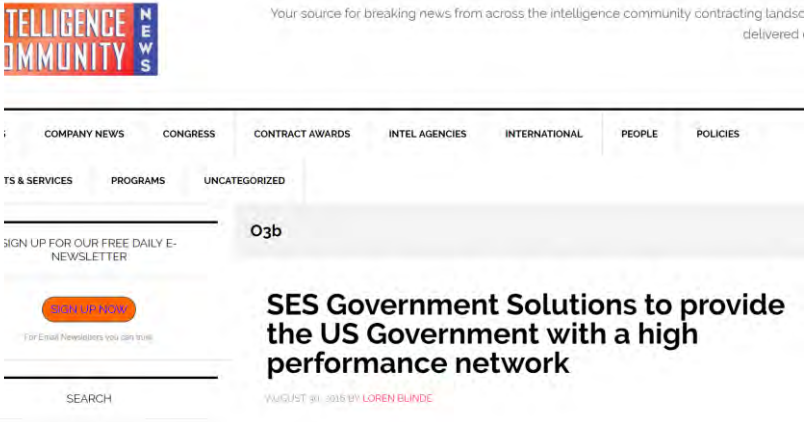



- O3b Supported Simultaneously
  - Multiple NIPERNet, SIPRNet, and JWICS Computer systems
  - Multiple SIPRNet Telephone calls
  - SIPRNet VTC
  - Full Motion uncompressed data dissemination

# Recent Press



# Support to CENTCOM

- O3b Networks supports CENTCOM through our SES Government Services (SES-GS) subsidiary
- Currently providing 2 x 432 MHz transponders, each capable of delivering over 2 Gbps in capacity
- Leasing equipment and bandwidth
- Providing full-time Field Service Representatives in theatre
- Leased line reach back into the DoDIN

For operational details contact
Chris Bush
USCENTCOM J6 Engineering
Emails
christopher.b.bush.ctr@mail.mil
bushcb@centcom.smil.mil
DSN – 529-6101
COM – (813) 529-6101
VoSIP – (302) 529-6244



# Support to US Forces Korea

- O3b Networks supports USFK through our SES Government Services (SES-GS) subsidiary
- Currently providing 432 MHz, capable of delivering over 2 Gbps in capacity
- Leasing equipment and bandwidth
- Providing full-time Field Service Representatives in theatre
- Leased line reach back into the DoDIN

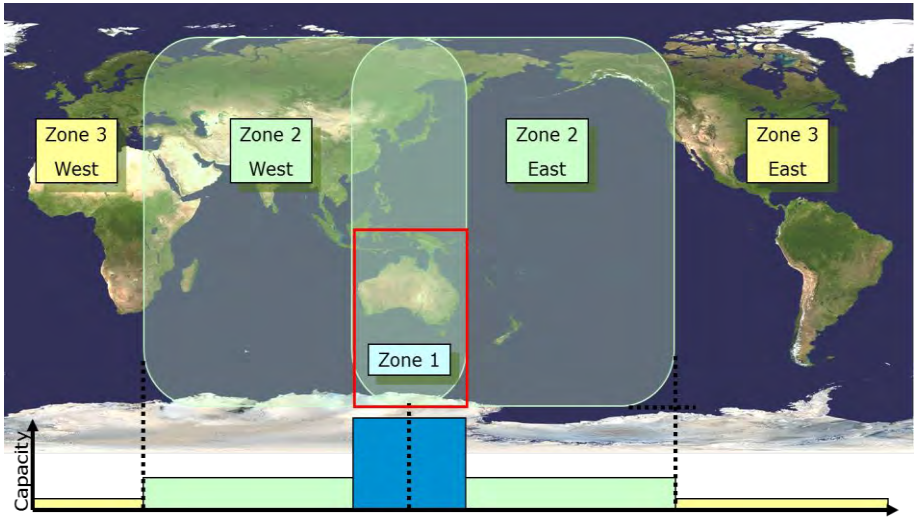


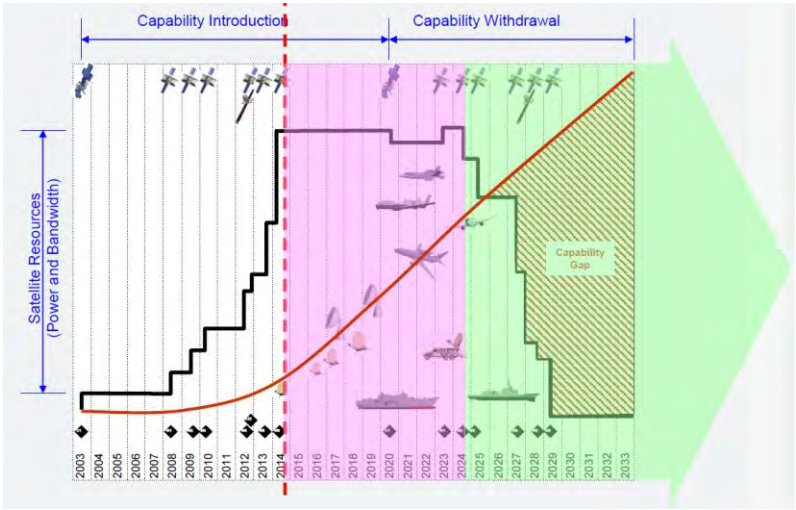


# OPTIONS FOR AUSTRALIA

SES Networks

# Australia
## Strategic fit



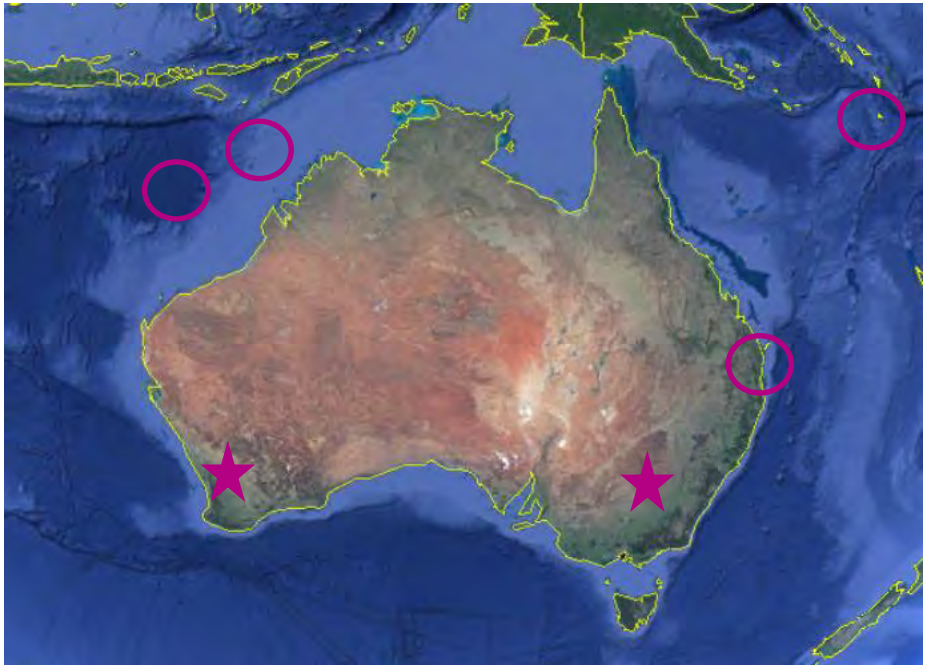




O3b addresses both Australia's geographic area of interest and the imminent SATCOM capability gap

# Australia
## Missions and Platforms

### Missions

- Maritime patrol
- Airborne ISR
- UAS ISR
- VIP/C2
- SAR
- Expeditionary forces
- Border protection
- Peacekeeping
- Special Forces
- Joint Exercises
- Counter Terrorism

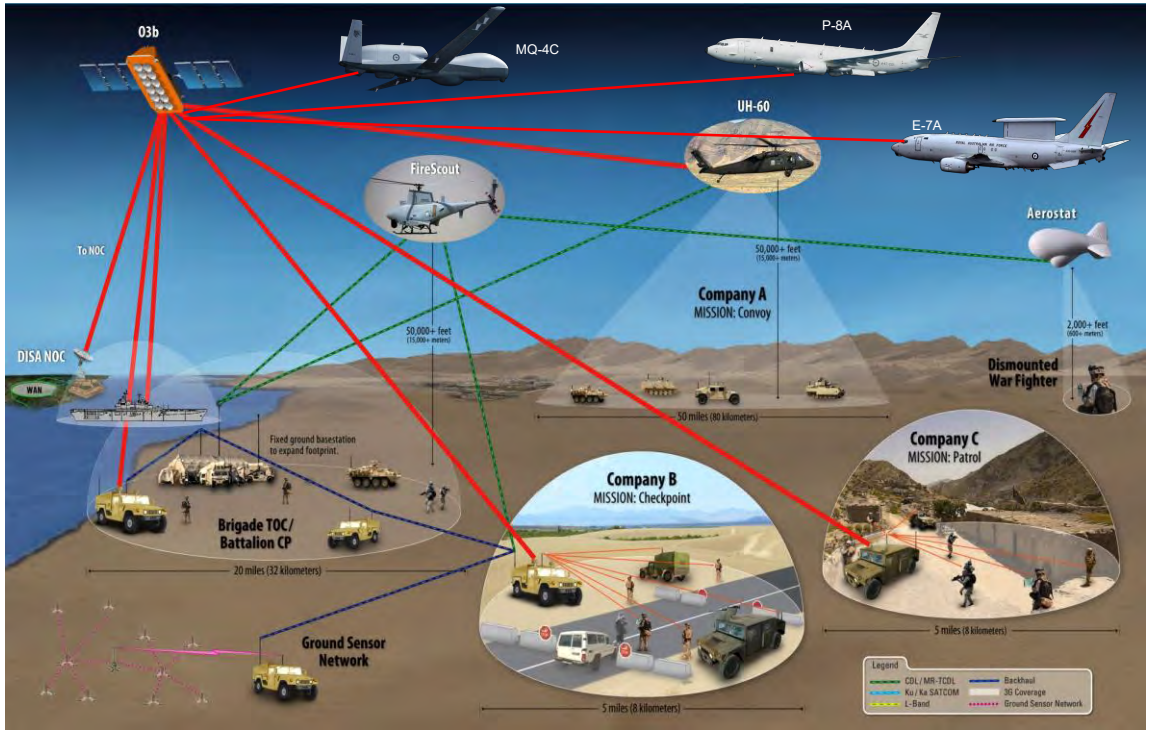


### Platforms

- Land
  - Portable (AVL)
  - COTM/COTP
  - LAND 400
- Sea
  - LHD/LSD
  - AWD
  - Future Frigate
  - OPV
- Air
  - E-7A Wedgetail
  - P-8A Poseidon
  - MQ-4C Triton
  - MH-60R
  - MRH-90
  - 737 BBJ
  - KC-30A
  - C-17
  - C-130

# Australia

## What is your CONOPS with Gigabit networking in theatre ?



**Glen Tindall**
Head, Government Sales, Asia-Pacific

Glen.Tindall@ses.com
M +61 478 753 322

**Connect with us**